PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference MK/CP/P12839PC	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB 03/01510	International filing date *(day/month/year)* 08.04.2003	Priority date *(day/month/year)* 09.04.2002
International Patent Classification (IPC) or both national classification and IPC G01N21/39		
Applicant UNIVERSITY OF STRATHCLYDE et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21.10.2003	17.05.2004
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Duijs, E Telephone No. +49 89 2399-7945

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB 03/01510

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-29 as originally filed

Claims, Numbers

1-27 received on 22.03.2004 with letter of 18.03.2004

Drawings, Figures

1a-1h, 2, 3a, 3b, 4a-4c, 5, 6a, 6b, 7-18, 19a, 19b, 20, 21 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-27
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-27
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-27
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V.

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: Werle P. ET AL, "Near- and mid-infrared laser-optical sensors for gas analysis", Optics and Lasers in Engineering (02-2002), 37(2-3), 101-114

D2: US-A-5636035

2. **Novelty and Inventive Step (Art. 33(2)(3) PCT):**

Method claims 1-12 and **apparatus claims 13-27** do meet the criteria of Articles 33(2) and 33(3) PCT for the following reasons:

2.1 Document **D1**, which is considered to represent the **most relevant state of the art**, discloses (the references in brackets refer to D1):

2.1a **Method claim 1**

- A method for sensing gases using a semiconductor diode laser spectrometer (abstract);
- introducing a sample gas into a non-resonant optical cell (page 108, lines 32-33; fig. 3a) having reflecting elements (impl. page 108, line 7, "181 reflections");
- applying a step function electrical pulse to a semiconductor diode laser to cause the laser to output a continuous wavelength chirp (page 108, lines 26-27; page 106, lines 25-29; fig. 4a);
- injecting the wavelength chirp into the optical cell (page 4a, lines 6-7, 25-30; figs. 3a and 4a);
- using the wavelength variation provided by the wavelength chirp as a wavelength scan (page 108, line 26);
- detecting light emitted from the cell (page 108, lines 7-9; figs. 3a and 4a);

2.1b **Apparatus claim 13**

- A semiconductor diode laser spectrometer (figs. 3a, 4a; abstract);
- a semiconductor diode laser (chapters 2 and 3, pages 102-107; "QC laser", page

104, lines 11-12);
- a non-resonant optical cell (page 108, lines 6-7, "Herriot cell") having reflecting elements at either end thereof (impl. page 108, line 7, "181 reflections");
- an electric pulse generator adapted to apply a substantially step function electrical pulse to the laser to cause the laser to introduce a continuous wavelength chirp into the sample cell (page 108, lines 25-29; "adjust DC current", "1 kHz ramp", "additionally modulated at high frequency"; fig. 4a);
- a detector (page 108, lines 7-9, "InGaAs detector").

2.2 **Technical Problem**: In D1 it is stated on page 106, lines 30-33, that the wavelength scan provides that "unwanted spectral features due to interfering species or etalon fringes can easily be identified". This means that interference fringes occur using the method of D1, which results in the need for complicated fringe identification and/or removal techniques in order to improve the signal to noise ratio and to allow features to be identified in the scans with more accuracy.

2.3 **Solution**: The present invention differs from D1 in that "a chirp rate is used such that there is a time delay between the spots on the reflecting elements sufficient to prevent light interference occurring in the optical cell". No hint for this solution can be found in any of the cited prior art documents.

2.4 **D2** discloses a method and apparatus for dual modulation laser absorption spectroscopy that "substantially reduces unwanted interference fringes" (col. 4, lines 15-18). This is an alternative method with respect to the present invention in which not a chirp rate is set such that "a time delay between spots on the reflecting elements" of the optical cell is generated, but in which the tunable laser is frequency modulated at a first frequency while further modulating the tunable laser with a triangular waveform having a second frequency. The absorbance signal detected by the detector is demodulated using a second harmonic of the triangular waveform frequency.
The method presented in D2, therefore, differs from the present invention; it would not be obvious to the skilled person to modify said method to arrive at the solution of the present invention.

3. The requirement of **Art. 33(4) PCT as to Industrial applicability** is fulfilled for all independent and dependent claims.

4. Clarity (Art. 6 PCT) and further comments (for the sake of completeness):

4.1 Claim 13 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. In lines 9-12, the claim attempts to define the subject-matter in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical apparatus features necessary for achieving this result. "The chirp rate used" is no clear apparatus feature. It should be noted that, for example, claims 15 and 16, define "means for varying the rate of change of wavelength per unit time of the chirp".

4.2 The embodiment of the invention described on page 6, lines 25-31; page 24, lines 17 - page 26, line 10 and shown in figures 17 and 18 does not fall within the scope of the claims. The claims are limited to "a non-resonant optical cell having reflecting elements". This inconsistency between the claims and the description leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear, Article 6 PCT.

4.3 The vague and imprecise statement ("**spirit of the invention**") in the description on page 28, lines 30-32 implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT, PCT Guidelines, III-4.3a) when used to interpret them.

4.4 Contrary to the requirements of Rule 5.1(a)(ii) PCT, **the relevant background art** disclosed in the **documents D1 and D2** is not mentioned in the description, nor are these documents identified therein.

4.5 **Claims 1 and 13** are not clearly in the **two-part form** (Rule 6.3(b) PCT).

4.6 The features of the claims are not provided with **reference signs** placed in parentheses (Rule 6.2(b) PCT).